

## **NOTE ON DETERMINATION OF PREMIUM RATES FOR MOTOR VEHICLES (THIRD PARTY RISKS) INSURANCE IN NEW ZEALAND**

By J. E. ERIKSEN, F.I.A., A.S.A., A.I.S. AND E. J. JONES, F.I.A.

### *Introduction*

THE authors have advised on the level of motor vehicle (third party risks) insurance rates of premium in the circumstances under which that business is written in New Zealand and this paper records the approach taken. It has been prepared in the hope that, as no difficult mathematics are involved, the basic ideas may appeal both to actuaries and to persons other than actuaries who are interested in the transaction of non-life insurance. They are relevant not merely to third party motor insurance but also to non-life insurance generally in a situation where insurance is compulsory and the rates of premium are centrally controlled. In those circumstances more sophisticated techniques of deriving premium rates are less necessary.

### *Background*

Every motor vehicle operated on New Zealand roads is required by legislation to be insured against the owner's (or his driver's) liability for damages as a result of injury or death arising from the negligent use of the vehicle. The transport legislation also provides indemnity in respect of victims killed or injured by the negligent use of uninsured or unidentified vehicles.

The actual process of insuring the vehicle is an integral part of the annual vehicle licensing procedure which takes place on 30 June in each year for all classes of motor vehicles. The owner nominates an insurance company on the licence application and, upon payment of the combined licence fee and third party insurance premium, the contract of insurance automatically takes effect. Each type of vehicle is placed in one of twelve insurance classes, e.g. motor cycles, power cycles, motor cars and rental cars are placed in separate categories. The licence fees and insurance premiums depend only on the type of vehicle and do not vary according to age of driver, accident record, whether the vehicle is driven in rural or urban areas, or any other factor. After deducting licence and certain other fees a uniform amount for every contract of insurance is retained by the licensing authority to cover its administration expenses, the balance being paid to the insurance company concerned.

Because the insurance is compulsory and competition between insurance companies is not possible by means of premium rates, the Ministry of Transport is represented on the committee which recommends the rates of premium to be charged.

*Problem*

To assist the committee to fix equitable rates, the New Zealand Government Statistician made some studies in 1964 of the profitability of the business but owing to the long 'tail' of the claims experience it was not possible to produce final figures except in respect of business written some ten years earlier. Of course the insurers had been making estimates of outstanding claims but the Government Statistician showed that these estimates were always on the high side and the deviations fluctuated widely from year to year both in absolute and in percentage terms. His study showed that in the late 1940s claims payments for each registration year were on average about 85% of premiums for the same year, but there was a substantial period in the 1950s when claims payments were well below 85% of premiums followed by a period in the early 1960s when payments were likely to be more than 85% of premiums.

The insurers felt that the business had been transacted on unprofitable terms but the demonstration of this fact was proving extremely difficult and they sought independent actuarial advice. The determination of premium rates and the method of accounting both rested on foundations which were to some extent arbitrary and subjective. Agreement was reached that the objective was to set a premium under which, ignoring interest, the margin for insurance companies' administrative expenses and profits would be 12½% of premiums.

A unique situation existed in that we were dealing with a complete population in the statistical sense. How then to decide appropriate rates of premium which were not only fair but demonstrably so?

The premium advisory committee is apparently prepared to recommend premiums under which past losses can be recovered and gains carried forward so that the claims ratio over a period averages out at the agreed figure. It could be argued, therefore, that the actual premium rate paid in any one year is not of vital concern but the following factors suggest that the best estimate of the claims experience should be used.

- (a) In the public interest the lowest premiums should be charged.
- (b) It is desirable to have premiums which do not fluctuate wildly.
- (c) The share of the market enjoyed by any one insurer can change from year to year; each insurer may therefore not recover past losses if inadequate premiums are charged; conversely a new entrant or an expanding company will not want to provide cover for premiums which contain a deduction on account of past gains carried forward.
- (d) The possibility of discontinuing this type of insurance has existed since the publication in 1967 of the findings of the Royal Commission on Personal Injury in New Zealand (the Woodhouse Report). The opportunity to recoup past losses would thereupon cease.

*Initial Approach*

The general approach to the problem of determining premium rates was that the previous year's premium would be adjusted to allow for:

- (a) the long-term trend in claims;
- (b) the results of the actual past experience of insurers taken as a whole.

The first factor is to counter inflation of claims and a rate of  $4\frac{1}{2}\%$  per annum was considered appropriate.

In order to calculate the second factor it was proposed that reserves should be set up out of net premium payments so that each year's premium income would run off over a period of years. Profitability would be calculated by comparing actual claims with the allowance in the premiums. The basic principle underlying the approach was to release the premiums concurrently with the estimated emergence of claims. The system is closely analogous to the valuation of a life policy on the premium basis.

Perhaps it should be mentioned that as each category of vehicle enjoys uniform insurance cover there is little point in separating the claims rate into its components of the rate at which accidents occur and the average amount of claim. There is even less point in investigating the dispersion of claim size. Even if the risk of suffering an accident were reducing at a time when the average cost of each claim were increasing we consider that only the combined 'claim rate' need be investigated because we are dealing with a complete statistical population. Also the combined claims rate when expressed in terms of the original premium is not unlike a mortality investigation based on sums assured rather than lives assured.

The last five insurance years which were complete at the time of our initial investigation yielded the following pattern of emerging claims.

Year	Proportion of claims paid in various years from date of insurance					
	1st	2nd	3rd	4th	5th	6th
1955-56	9.1	38.8	34.0	13.5	3.6	1.0
1956-57	9.7	39.1	34.4	13.8	2.3	0.7
1957-58	10.1	31.2	32.0	21.3	5.4	—
1958-59	8.4	36.6	34.9	16.7	3.4	—
1959-60	8.8	29.0	34.6	22.2	5.4	—
Average	9.2	35.0	34.0	17.5	4.0	0.3
Proportion of claims outstanding at beginning of each year	100.0	90.8	55.8	21.8	4.3	
As percentage of premiums after allowing for $12\frac{1}{4}\%$ expenses at time of inception	87.5	79.5	48.8	19.1	3.8	

For practical purposes it was thought appropriate to set up reserves calculated on the following basis:

Number of years from date of insurance	Percentage of premiums to be reserved for outstanding claims
1	80
2	50
3	20
4	5

The surplus each year was calculated from a global account as follows:

Reserve for outstanding claims at commencement of year of account	$R_0$	
plus premiums received during year of account	P	
less allowance for expenses and profit of $12\frac{1}{2}\%$ of premiums received	E	
claims paid during year of account	C	
reserve for outstanding claims at end of year of account	$R_1$	
		<hr/>
Net Surplus		$S$

The net surplus  $S$  is a one-year estimate of profitability. In effect we compare

$$P - E - C$$

with the change in reserves found by applying the same set of percentages to the relevant premiums. The differences in the percentages which apply to the same insurance year allow appropriate proportions of the premium for that year to be released to meet expected claims in successive development years.

The premium for the following year could then be determined by reference to the premium charged for the previous year after adjustment to allow firstly for the long-term trend and secondly for the accumulated surplus or deficit. The cumulative experience of previous years would thus be reflected in the determination of future premiums.

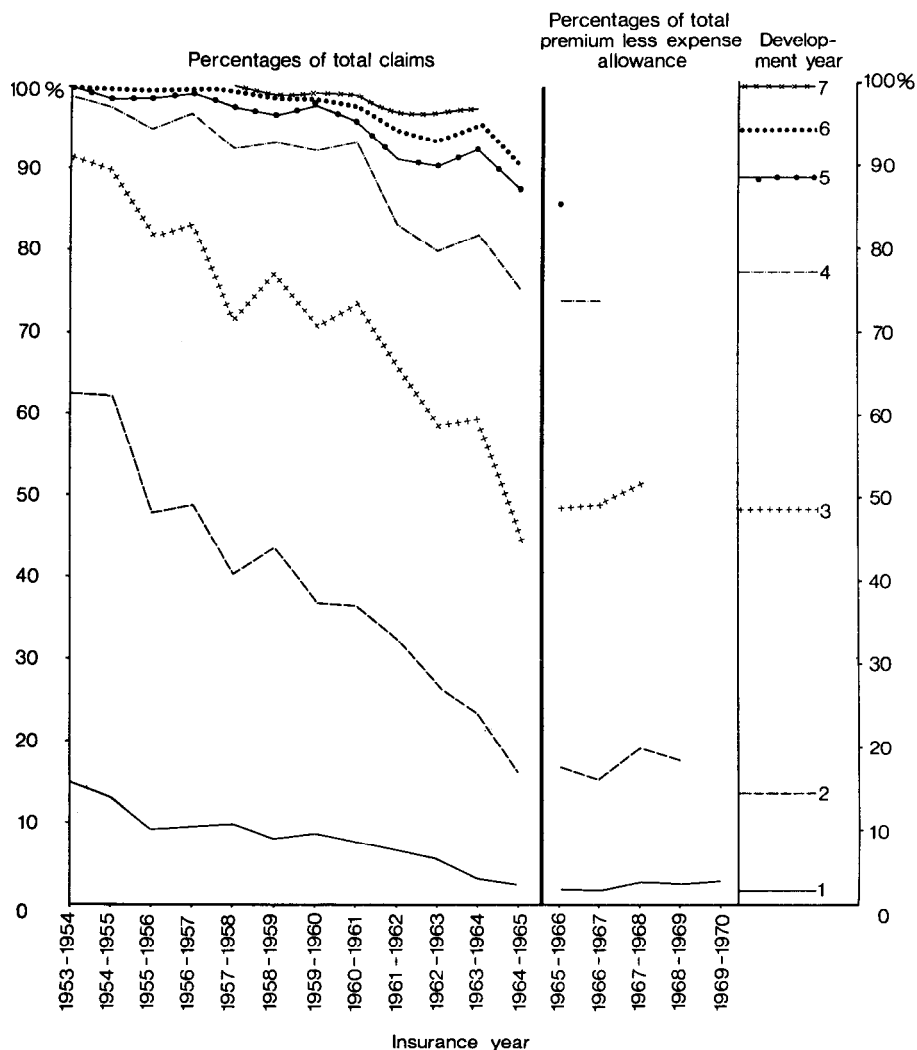
It was thought that the system would be self-correcting in the long term although large surpluses and deficits could arise in the short term because reserves were based on premiums. Inadequate reserves are therefore set up when premiums are inadequate and vice versa. Because of the time lag before changing experience is reflected in changing premiums, the profitability curve could resemble a sine wave. This was deemed to be acceptable at the time of adoption of the original formula.

### *Modified Approach*

Although the system was ultimately self-correcting for levels of claims experience, an explosion occurred in the period over which claims were spread. It became apparent that the method was too slow in reflecting adverse experience

in the premium rate determination. A further examination of the spread of claim payments revealed that the tail of the business was continuing to lengthen in a striking manner, and that the fluctuations about a rough mean shown up in the first study was a transitory feature of the experience. The graph attached illustrates the trend very plainly.

Cumulative Distribution of Claim Payments by Development Year



This explosion created a paradoxical effect because surpluses were built up in the notional account owing to the smaller number of claims settled in the early years; at the same time the insurers were suffering losses arising from the creation of reserves against claims reported but not settled. We therefore proposed that the rigidity of the fixed percentage of premiums incorporated in the reserve calculation should be discontinued. Instead, the coefficients for the out-going reserves should be determined afresh each year in the light of the most up-to-date data available at the time.

To preserve continuity in the determination of accumulated surplus the incoming reserves must obviously remain equal to the out-going reserves in the previous year.

We believe now that the system proposed is a viable one but that the premium rate for the next following year should be determined by reference to the premium rate for the previous year after allowing for:

- (a) a long-term adjustment for inflation which would reflect current experience regarding the movement of wage rates and cost of living;
- (b) an adjustment to bring the last insurance year's experience to parity;
- (c) an adjustment to recover past losses or to distribute past surpluses.

The adjustment under paragraph (b) can be calculated by means of the notional account as set out on page 152 for the last year applying identical coefficients to the premiums paid for the relevant insurance years to obtain values for  $R_0$  and  $R_1$  provided that the differences between the coefficients which relate to the development year under consideration are considered representative of the emerging experience.

The adjustment under item (c) can be calculated by the normal life office approach. The surplus at the end of the year would be determined by differencing the amount of the fund and the reserve at the end of the year. This difference would represent the accumulated past surpluses and deficits for all previous insurance years.

Since the analysis can only be performed after the close of each financial year it is possible for the results to affect the determination of premiums only for the financial year following that in which the analysis is performed; the premiums for the current year will have already been determined. The adjustment for inflation, therefore, needs to cover a two-year period when applied to the premium for the year under analysis. Expressed symbolically the premium for the next year takes the form

$$A(2) = A(0) (1+j)^2 - S - \frac{(F-R)}{n}$$

where

$j$  = assumed rate of inflation

$S$  = notional surplus emerging from the last year's experience determined by the application of up-to-date values for  $M(t)$  to the actual values of  $P(t)$

for all values of  $t$ , for the purpose of obtaining both incoming and outgoing reserves

$F$  = accumulated fund

$R$  = reserve for future claims

$n$  = period over which accrued surplus is to be spread.

The reserve for future claims can be expressed generally as

$$R = \sum P(t) M(t)$$

where

$M(t)$  = proportion of premiums reserved for claims occurring after duration  $t$

$P(t)$  = premium received  $t$  years ago.

### *Objectivity*

Whilst the above system has provided rates of premium which are in our opinion satisfactory for motor vehicle third party cover in New Zealand, we are conscious that there are subjective elements in two important areas, namely:

- (a) The period over which past losses or profits are to be spread, i.e. the value assigned to  $n$ .
- (b) The precise determination of the percentage of each premium to be reserved for the claims in respective development years, i.e. the shape of  $M(t)$ .

Dealing with point (a) we are currently inclined to think that a period of three years is reasonable over which to recoup past losses or to spread past surpluses. At a time when premium rates are fairly close to experience the adjustment will in any event be of little significance. The only time when the adjustment will be substantial will be during periods of rapid change in the experience and we believe that a period longer than three years may then be unsatisfactory over which to recoup losses because of the probability that further adjustments will be required on account of further changes before the account has been squared in respect of past experience.

Dealing with the proportion of each premium to be reserved for each development year we are unable at this stage to produce a method which appears superior to the determination of factors based on the visual consideration of a graphical representation of the analysis of past experience according to development year. A diagram in the form of the graph on page 153 was found valuable for this purpose.

We believe that the analysis of the experience for those years where the experience is still open can also contribute to the determination of the percentages under consideration. Because the analysis in respect of open years cannot be determined in respect of total claims we have expressed the percentages in terms of total premiums. The relative percentages will, therefore, require adjustment to take account of the ultimate adequacy of the premiums in meeting total claims. During the period when the experience is still open any such adjustment must contain some element of subjectivity.

*Special Characteristics*

The above remarks apply to the special situation referred to which differs from the position of non-life insurers generally in several aspects, e.g.

1. An entire national account is involved with an implied continuity of business. This feature is one reason for the omission of any contingency margins in the formulae and the treatment of the accrued surplus.
2. The omission of interest earnings from the formulae is noteworthy. This formed part of the bargain struck by the insurers when the expense margin was fixed.
3. All premiums are payable at the beginning of the year of account.
4. Expenses are allowed for only at the time of premium payment.
5. There is no element of selection of type or amount of cover; all licensed motor vehicles in New Zealand enjoy the same third party insurance cover.